Time-scales of Crustal Melting within the Leo Pargil Dome, NW India

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Dome complexes within the Himalayan orogen are dominantly composed of amphibolite-facies metapelites intruded by dikes and sills of leucogranite resulting from mobilization and amalgamation of batches of in-situ partial melt. These exposures provide an exceptional opportunity to study the time-scales of melt generation in the mid-crust and the mechanisms of melt transport and emplacement within a well-defined structural framework. Knowledge of the dynamics of crustal-melting and the inter-relationships between metamorphism, melting, and exhumation play a key role in evaluating competing models of dome formation within the Himalaya, and potentially have important implications for understanding the rheologic evolution of the mid-crust during collision.

Located in the northwestern Himalaya, the northeast-striking Leo Pargil dome (LPD) consists of a high-grade metamorphic and anatectic core surrounded by low-grade Tibetan metasedimentary rocks. Exhumation of the LPD has previously been ascribed to extensional unroofing processes controlled by a large-scale detachment fault system, the Leo Pargil shear zone (LPSZ) (Thiede and others, 2006). Normal-sense displacement on this structure has resulted in juxtaposition of kyanite-bearing gneiss in the footwall beneath lower-grade rocks in the hanging wall.

Leucogranitic dikes and sills pervasively intrude the footwall of the LPSZ and, while less abundant, are also present in the hanging wall of the LPSZ. Individual intrusions are relatively small in volume and extent, ranging from 5 cm to 2 m wide by 20 cm to >100 m long, and form a complex network of cross-cutting bodies distinguishable by differences in mineralogy and chemistry. Solid-state fabric development in the leucogranites varies from moderately and weakly foliated to isotropic, indicating both syn- and post-kinematic emplacement with respect to the dominant tectonic fabric in the host gneisses. Deformed and undeformed leucogranites found within the LPSZ provide minimum age constraints for movement along the LPSZ.

U-Th-Pb monazite ages from the leucogranites range from ~26-16 Ma, with individual samples exhibiting discrete age populations consistent with cross-cutting relationships. The majority of individual melt batches appear to be relatively short-lived, forming on the sub million-year time-scale. Field relationships and detailed geochronology suggest that, in contrast to other domes (e.g. Cottle and others, 2009), melting within the LPD occurred over a protracted period (>10 Ma). Melt production and mobilization into dikes and sills likely resulted from semi-continuous production of melt by in-situ partial melting of the metamorphic host rock at different structural positions immediately prior to, and/or during, exhumation of the LPD. Transects examined thus far indicate strong evidence of a temporal link between magmatic events and exhumation of the dome. Further geochronologic work currently underway will attempt to document the scale of along-strike temporal variability in leucogranite formation with the goal of developing a 4-D model for melt generation within the LPD.

References

Cottle, J. M., and others, 2009, Geochronology of granulitized eclogite from the Ama Drime Massif: Implications for the tectonic evolution of the South Tibetan Himalaya, Tectonics, 28, TC1002.

Thiede, R.C., and others, 2006, Dome formation and extension in the Tethyan Himalaya, Leo Pargil, northwest India, Geol. Soc. Am. Bull., 118, 635−650.

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